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the OFFICE OF NAVAL RESEARCH and NEOCERA, INC.

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FIRST MONTHLY PROGRESS REPORT
dated October 21, 1994

1. Introduction

The goal of this SBIR Phase I project is to establish the feasibility of designing a High Temperature Superconductor (HTS) Superconducting QUantum Interference Device (SQUID) microscope in order to detect defects, and verify customizations and repairs in MCM substrates. The overall goal of this SBIR program is to market an HTS SQUID microscope dedicated to the inspection of MCM substrates in a manufacturing environment. Neocera and its subcontractor, the Center for Superconductivity Research at the University of Maryland, are working collaboratively in this effort.

Initial efforts have focused on: demonstrating that a room temperature object can be brought sufficiently close to a cryogenically-cooled SQUID sensor to image electrical defects (shorts, opens, voids, particulate contamination, etc.); constructing a room temperature sample stage; and assembling the sensor control and readout electronics.

2. Cold Sensor, Room Temperature Sample

A dewar for liquid cryogens (LN_2) was modified to accomodate a sensor and window assembly. The modified dewar will be secured to an aluminum support structure which is under construction. The sensor, held at 77K, must be brought as close as possible to the room temperature sample. To accomplish this, the sensor will be located adjacent to a thin, vacuum-tight window. By drawing a vacuum between sensor and window, the sensor can be maintained at cryogenic temperatures while the sample, located immediately opposite the sensor but outside the window, is at room temperature.

An initial attempt was made to test a potential window structure. It was found that a 10 μm -thick mylar sheet, tensioned across a 1 mm-diameter aperture and epoxied in place, will provide a vacuum seal good to below 10^{-6} Torr. Unfortunately, there is too much flexing under the pressure of atmosphere for use in the microscope. The preliminary conclusion is that a stiffer material will be needed. A possible choice is ultrathin single crystal sapphire, which Neocera can obtain in thicknesses as small as 25 μm . Diamond may also be considered, but presently available samples are opaque.

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3. Sample Stage

A scanning stage has been successfully connected to a computer, good spatial control and scanning speeds have been demonstrated with no vibration apparent. For these tests, a microwave microscopy technique was used which is sensitive to submicron flexing of the stage.

4. Electronics

Most of the assembly work for a set of feedback electronics for monitoring the SQUID was completed.

5. Plans for the Next Period

- Complete the dewar assembly
- Complete the electronics assembly
- Continue exploring window designs
- Work on design layout for the SQUID support structure internal to the dewar.

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